(19)日本国特許庁（ＪＰ）　(12) 登録実用新案公報（U）　(11)実用新案登録番号

第3005740号

(45)発行日　平成７年(1995)１月10日　(24)登録日　平成６年(1994)10月19日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ２３Ｇ　5/06	Ｂ	9135－3Ｃ		
	Ｃ	9135－3Ｃ		
Ｂ２３Ｂ　27/14	Ａ	9326－3Ｃ		

評価書の請求　有　請求項の数４　ＯＬ　（全 15 頁）

(21)出願番号　実願平6－7655

(22)出願日　平成６年(1994)６月28日

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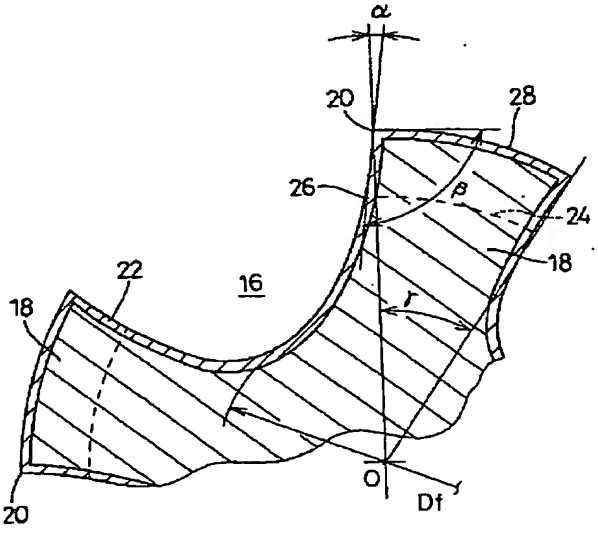
(54)【考案の名称】　高硬度材用ハンドタップ

(57)【要約】
【目的】　引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で且つ長寿命が得られるねじの呼び直径が３～１２ｍｍの高硬度材用ハンドタップを提供する。
【構成】　母材を高級粉末高速度工具鋼にて構成するとともに表面をチタニウム炭窒化物２２で被覆する一方、直みぞ１６のみぞ数（刃数）をＪＩＳの規定と同じかそれ以上とし、みぞ底の径Ｄｆを外径の略４０～６０％の範囲内とし、複数のランド１８の幅の中心角（刃厚角）γの総和Σγを略９５～１５０°の範囲内とし、切れ刃２０のすくい角αを略－８～０°の範囲内とした。



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【実用新案登録請求の範囲】

【請求項１】　谷の径が３～１２ｍｍのめねじを切削加工するための高硬度材用ハンドタップであって、
母材が高級粉末高速度工具鋼にて構成されているとともにねじ部の表面がチタニウム炭窒化物によって被覆されている一方、みぞ数は３以上で、みぞ底の径はねじ部の外径の略４０～６０％の範囲内で、刃厚角の総和は略９５～１５０°の範囲内で、切れ刃のすくい角は略－８～０°の範囲内であることを特徴とする高硬度材用ハンドタップ。

【請求項２】　前記みぞ底の径はねじ部の外径の略４２～５１％の範囲内で、前記刃厚角の総和は略１００～１２５°の範囲内である請求項１に記載の高硬度材用ハンドタップ。

【請求項３】　谷の径が３～６．５ｍｍのめねじを切削加工するための高硬度材用ハンドタップであって、みぞ数は４、みぞ底の径はねじ部の外径の略４２％である請求項１または２に記載の高硬度材用ハンドタップ。

【請求項４】　谷の径が６．５～１２ｍｍのめねじを切削加工するための高硬度材用ハンドタップであって、みぞ数は５、みぞ底の径はねじ部の外径の略５０％である請求項１または２に記載の高硬度材用ハンドタップ。

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【図面の簡単な説明】

【図１】本考案の一実施例である図２の高硬度材用ハンドタップのねじ部における軸心と直角な断面の一部を拡大した図である。

【図２】本考案の一実施例である高硬度材用ハンドタップを軸心と直角な方向から見た正面図である。

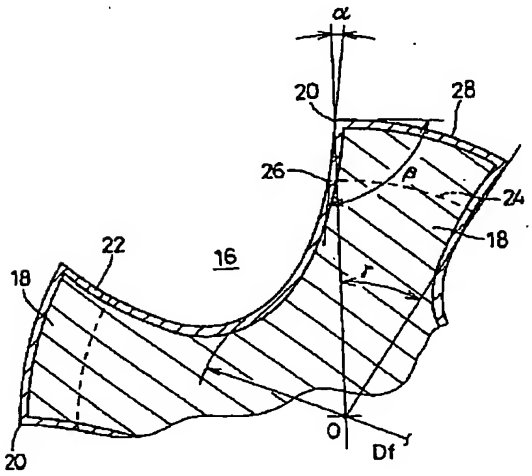
【図３】従来の通常のハンドタップのねじ部における軸心と直角な断面図である。

【図４】ねじ部の表面にチタニウム窒化物を被覆した従来のハンドタップのねじ部における軸心と直角な断面の一部を拡大した図である。

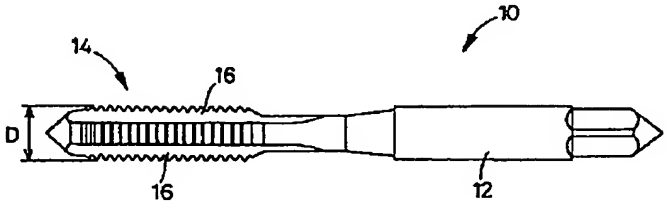
【符号の説明】

１０：高硬度材用ハンドタップ
１４：ねじ部
１８：ランド
２０：切れ刃
２２：チタニウム炭窒化物
Ｄ：ねじ部の外径
Ｄｆ：みぞ底の径
α：すくい角
γ：刃厚角

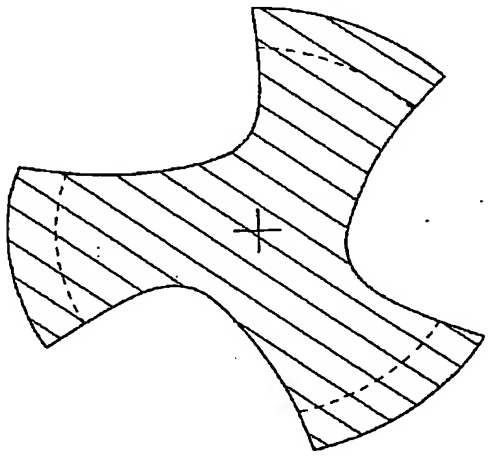
【図１】



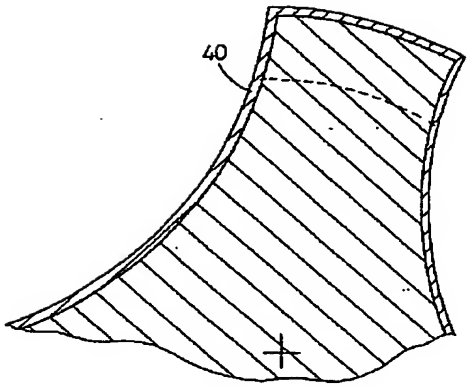
【図２】



【図３】



【図４】



【考案の詳細な説明】

【０００１】

【産業上の利用分野】

本考案はめねじを切削加工するハンドタップに係り、特に、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で且つ長寿命が得られる高硬度材用ハンドタップに関するものである。

【０００２】

【従来の技術】

めねじを切削加工するためにハンドタップが広く用いられているが、このようなハンドタップの基本構造はＪＩＳによりめねじの寸法に応じて細かく規定されており、例えばＪＩＳ　Ｂ４４３０には「メートル並目ねじ用等径ハンドタップ」について定められている。かかるＪＩＳの規定によれば、ハンドタップの材質は、合金工具鋼ＳＫＳ２若しくは高速度工具鋼ＳＫＨ９、または使用上これらと同等以上の性能をもつものと規定されている。また、特開昭６１－２４４４１２号公報には、チタニウム窒化物の被覆を施した直みぞタップ等であって、ねじ部の刃の少なくとも一部の弦フック角（すくい角に相当）が－９～－１°の範囲内とされた３みぞ仕様のものが記載されている。図３は上記ＪＩＳの規定による通常のハンドタップの一例のねじ部断面図で３みぞのものであり、図４は上記公報に記載のハンドタップのねじ部断面図で表面がチタニウム窒化物４０で被覆されている。

【０００３】

【考案が解決しようとする課題】

しかしながら、前記ＪＩＳの規定による通常のハンドタップを用いて、引張強さが１２５０～２０８０ＭＰａ程度の高硬度の被削材に対してねじ立てを行うと、タップ本体の折損や切れ刃の欠損，チッピング，早期摩耗などの不具合が生じ、実用上十分な加工能率，工具寿命が得られなかった。チタニウム窒化物を被覆したハンドタップの場合、耐摩耗性が向上するため通常の硬度の被削材に対しては優れた工具寿命が得られるようになるが、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しては、やはりタップ本体の折損や切れ刃の欠損など

によりねじ立て加工を行うことはできない。因みに、高速度工具鋼製ハンドタップの表面にチタニウム窒化物を被覆したものを用いて、引張強さが１６９５ＭＰａの合金工具鋼ＳＫＤ６１にＭ６×１のねじ立てを試みたところ、切れ刃のチッピングに起因する異常摩耗によりわずか１穴でねじ立てが不能となった。

【０００４】

本考案は以上の事情を背景として為されたもので、その目的とするところは、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で且つ長寿命が得られる高硬度材用ハンドタップを提供することにある。

【０００５】

【課題を解決するための第１の手段】

かかる目的を達成するために、第１考案は、谷の径が３～１２ｍｍのめねじを切削加工するための高硬度材用ハンドタップであって、母材が高級粉末高速度工具鋼にて構成されているとともにねじ部の表面がチタニウム炭窒化物によって被覆されている一方、みぞ数は３以上で、みぞ底の径はねじ部の外径の略４０～６０％の範囲内で、刃厚角の総和は略９５～１５０°の範囲内で、切れ刃のすくい角は略－８～０°の範囲内であることを特徴とする。

【０００６】

なお、上記高級粉末高速度工具鋼とは、例えば特開平５－１７１３７３号公報にて提案されている粉末高速度工具鋼であって、それまでにない組成を持ったものである。すなわち、Ｗ等量（Ｗ＋1.８Ｍｏ ウェート％）が２０％を超え、Ｃｏ，Ｖが５ウェート％以上であることにより、従来技術にては略６６ＨＲＣまでしか達成されなかったタップの母材硬さが７０ＨＲＣまで可能となった。

【０００７】

【作用】

このような高硬度材用ハンドタップにおいては、母材が高級粉末高速度工具鋼であるため基本的に高強度，高剛性が得られるとともに、切削加工を行うねじ部の表面にはチタニウム炭窒化物が被覆されているため、前記チタニウム窒化物の被覆に比較して引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても優れた耐摩耗性が得られる。また、みぞ数は３以上、すなわちＪＩＳの規定

と同じかそれ以上で、みぞ数を多くすれば食付き部の１刃当たりの切込み量が小さくなるため、切削加工時の切れ刃の負担が軽減される。しかし、切りくずの排出性能を維持しながらみぞ数を多くすると刃厚が狭くなり、切れ刃の負担が軽減されるとはいっても欠損などの不具合が生じ易くなるため、みぞ数はＪＩＳの規定より１または２程度増やすのが限度である。

【０００８】

みぞ底の径はねじ部の外径（加工すべきめねじの谷の径）の略４０～６０％の範囲内で、通常のハンドタップに比べて大きめであり、強度や剛性が向上して折損し難くなる。外径に対するみぞ底の径の割合が大きい程強度や剛性は向上するが、この割合が大きくなるに従ってみぞの断面積が小さくなり、切りくずつまりが生じ易くなるため、このような得失を考慮して上記範囲は定められている。また、切りくずの大きさ、すなわちねじ山の高さはねじ部の外径に比例せず、ねじ部の外径が小さくなる程相対的に大きくなり、大きなみぞ断面積を確保する必要があることから、ねじ部の外径が小さくなる程上記割合を低くすることが望ましい。すなわち、上記４０～６０％の範囲は、ねじ部の外径の相違についても考慮して定められているのであり、外径が大きい場合は上記範囲内の比較的高域部分で設定することが望ましく、外径が小さい場合は上記範囲内の比較的低域部分で設定することが望ましいのである。みぞ数すなわち刃数によって切りくずの大きさは変化し、切りくずつまりの発生し易さが変わるため、上記みぞ底の径の設定に際してはみぞ数についても考慮する必要がある。

【０００９】

刃厚角の総和は略９５～１５０°の範囲内で、この角度が大きい程刃厚が広くなって強度や剛性が高くなり、欠損などの不具合が生じ難くなるが、角度が大きくなるに従ってみぞの断面積が小さくなり、切りくずつまりが生じ易くなるため、このような得失を考慮して上記角度範囲は定められている。また、みぞ数が多い程１つの刃厚やみぞ断面積は小さくなるし、切りくずの大きさはねじ部の外径やみぞ数によって異なるため、そのようなみぞ数やねじ部の外径を考慮して、切りくずつまりを生じることなく十分な強度や剛性が得られるように上記角度範囲は定められている。言い換えれば、個々のハンドタップにおける刃厚は、みぞ数

やねじ部の外径を考慮して上記角度範囲内で設定することになるのである。

【００１０】

切れ刃のすくい角は略－８～０°の範囲内であるため、すくい面と外周逃げ面とによって構成される切れ刃と直角な断面における刃物角が通常のハンドタップに比べて大きめとなり、強度や剛性が向上して刃欠けやチッピングの発生が抑制される。すくい角が小さい（マイナス側に大きくなる）程刃物角が大きくなって切れ刃の強度や剛性は向上するが、すくい角が小さくなるに従って切削抵抗が大きくなるため、このような得失を考慮して上記範囲は定められている。また、このように負のすくい角を採用すると、高硬度被削材の場合の切りくずは剪断形になって比較的小さく分断されるため、前記みぞ底の径や刃厚を大きくすることによってみぞ断面積が小さくなっても切りくずつまりが良好に回避される。

【００１１】

【第１考案の効果】

このように、本考案の高硬度材用ハンドタップによれば、加工すべきめねじの谷の径すなわちねじ部の外径に応じて、みぞ数やみぞ底の径，刃厚，すくい角を上記所定の範囲内で適当に設定することにより、切りくずつまり等による切削抵抗の上昇を抑制しながら、母材が高級粉末高速度工具鋼であることと相まって優れた強度，剛性が得られるようになるとともに、チタニウム炭窒化物の被覆によって高い耐摩耗性が得られるようになり、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で、例えば熱処理後にねじ立てを行うことができるようになるとともに、実用上十分な工具寿命が得られるようになる。

【００１２】

【課題を解決するための第２の手段】

第２考案は、上記第１考案の高硬度材用ハンドタップにおいて、前記みぞ底の径がねじ部の外径の略４２～５１％の範囲内で、前記刃厚角の総和が略１００～１２５°の範囲内であることを特徴とする。

【００１３】

【作用および第２考案の効果】

すなわち、この第２考案の高硬度材用ハンドタップは、第１考案に比較し、みぞ底の径および刃厚について、切りくずつまり等による切削抵抗の上昇を抑制しながら更に優れた強度，剛性が得られるように設定範囲を限定したもので、高硬度被削材に対する加工性能が一層向上する。

【００１４】

【課題を解決するための第３の手段】

第３考案は、上記第１考案または第２考案の高硬度材用ハンドタップのうち谷の径が３～６．５ｍｍのめねじを切削加工するためのもので、みぞ数を４、みぞ底の径をねじ部の外径の略４２％としたことを特徴とする。

【００１５】

【作用および第３考案の効果】

この第３考案は、谷の径が３～６．５ｍｍのめねじを切削加工するための高硬度材用ハンドタップに関するもので、ねじ部の外径が３～６．５ｍｍと比較的小さいため、切りくずの排出性能などを考慮してみぞ数を４、みぞ底の径をねじ部の外径の略４２％に限定したのであり、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で且つ実用上十分な工具寿命が得られる。

【００１６】

【課題を解決するための第４の手段】

第４考案は、上記第１考案または第２考案の高硬度材用ハンドタップのうち谷の径が６．５～１２ｍｍのめねじを切削加工するためのもので、みぞ数を５、みぞ底の径をねじ部の外径の略５０％としたことを特徴とする。

【００１７】

【作用および第４考案の効果】

この第４考案は、谷の径が６．５～１２ｍｍのめねじを切削加工するための高硬度材用ハンドタップに関するもので、ねじ部の外径が６．５～１２ｍｍと比較的大きいため、切りくずの排出性能などを考慮してみぞ数を５、みぞ底の径をねじ部の外径の略５０％に限定したのであり、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で且つ実用上十分な工具寿命

が得られる。

【００１８】

【実施例】

以下、本考案の実施例を図面に基づいて詳細に説明する。

図２は、本考案の一実施例である高硬度材用ハンドタップ１０（以下、単にハンドタップ１０という）を軸心と直角な方向から見た正面図で、Ｍ６×１すなわち谷の径が６ｍｍでピッチが１ｍｍのめねじを切削加工するためのものであり、シャンク部１２およびねじ部１４を備えているとともに、ねじ部１４には加工すべきめねじに対応する外径が６ｍｍのおねじが設けられている。図１は、ねじ部１４の軸心Ｏと直角な断面図であるが、ねじ部１４には４本の直みぞ１６が軸心と平行に設けられて４つのランド１８に分断されており、各ランド１８の端部に切れ刃２０が設けられている。このハンドタップ１０の母材は、前記W等量（W＋1.８Mo ウェート%）が２０%を超え、Co，Vが５ウェート%以上である高級粉末高速度工具鋼で、ねじ部１４の表面はチタニウム炭窒化物２２によって被覆されている。チタニウム炭窒化物２２は、例えばＣＤＶなどによって設けることができる。また、上記直みぞ１６のみぞ底の径Ｄｆの、ねじ部１４の外径Ｄに対する割合Ｒｄ（%）、すなわち（Ｄｆ／Ｄ）×１００は略４２%で、４つのランド１８の幅（刃厚）は等しく、刃厚角γの総和Σγは略１２０°で、切れ刃２０のすくい角αは－８～０°程度である。なお、図１の破線２４はねじの谷底を表している。

【００１９】

このようなハンドタップ１０においては、母材が高級粉末高速度工具鋼であるため基本的に高強度，高剛性が得られるとともに、切削加工を行うねじ部１４の表面にはチタニウム炭窒化物２２が被覆されているため、チタニウム窒化物の被覆に比較して引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても優れた耐摩耗性が得られる。また、直みぞ１６は４本設けられ、ＪＩＳの規定では「３または４」であるが一般には「３」であるのに対して１本多く、食付き部の１刃当たりの切込み量が小さくなるため、切削加工時の切れ刃２０の負担が３／４程度に軽減される。みぞ数が多くなると刃厚が狭くなり、切れ刃２０の負

担が軽減されるとはいっても欠損などの不具合が生じ易くなるが、本実施例ではみぞ数が４であるため、欠損などの不具合を回避しつつ切れ刃２０の負担を軽減できる。

【００２０】

みぞ底の径の割合Ｒｄは略４２％で、通常のハンドタップの場合が略３６％程度であるのに比べて大きく、強度や剛性が向上して折損し難くなる。Ｒｄ＝３６％の場合に比べると、（４２／３６）の２乗に比例して耐折損性は向上する。割合Ｒｄが大きい程強度や剛性は向上するが、この割合Ｒｄが大きくなるに従ってみぞ断面積が小さくなり、切りくずつまりが生じ易くなるとともに、切りくずの大きさはねじ部１４の外径すなわち加工すべきめねじの大きさやみぞ数によって異なり、切りくずつまりの発生し易さが相違するため、上記Ｒｄ≒４２％の数字は、それ等を総合的に考慮して切りくず排出性を損なうことなく十分な強度，剛性が得られるように定められている。

【００２１】

刃厚角γの総和Σγは略１２０°でみぞ数に比較して大きく、各刃厚が比較的広くて高い強度や剛性が得られ、欠損などの不具合が生じ難い。みぞ数が同じであれば総和Σγが大きくなるに従ってみぞ断面積が小さくなり、切りくずつまりが生じ易くなるが、切りくずの大きさはねじ部１４の外径やみぞ数によって異なるため、上記Σγ≒１２０°の数字は、そのようなみぞ数やねじ部１４の外径などを考慮して切りくずつまりを生じることなく十分な強度や剛性が得られるように定められている。

【００２２】

切れ刃２０のすくい角αは略－８～０°程度であるため、すくい面２６と外周逃げ面２８とによって構成される切れ刃２０と直角な断面における刃物角βが略９０°程度かそれ以上となり、通常のハンドタップに比べて大きいため、強度や剛性が向上して刃欠けやチッピングの発生が抑制される。すくい角αが小さい（マイナス側に大きくなる）程刃物角βが大きくなって切れ刃２０の強度や剛性は向上するが、すくい角αが小さくなるに従って切削抵抗が大きくなるため、このような得失を考慮して上記すくい角αは定められている。また、このようにすく

い角αが負の場合には、高硬度被削材にねじ立てを行った時の切りくずが剪断形になって比較的小さく分断されるため、前記みぞ底の径Ｄｆや刃厚を大きくすることによってみぞ断面積が小さくなっても切りくずつまりが良好に回避される。

【００２３】

したがって、このような本実施例のハンドタップ１０によれば、切りくずつまり等による切削抵抗の上昇を抑制しながら優れた強度や剛性、耐摩耗性が得られるようになり、引張強さが１２５０～２０８０ＭＰａ程度の高硬度被削材に対しても高能率加工が可能で、例えば熱処理後にねじ立てを行うことができるようになるとともに、実用上十分な工具寿命が得られるようになる。

【００２４】

なお、上例ではねじのサイズがＭ６×１のハンドタップ１０について具体的に説明したが、本考案は呼びがＭ３～Ｍ１２の範囲内の種々のサイズのハンドタップに適用することが可能で、その幾つかの具体例についてみぞ数およびみぞ底の径の割合Ｒｄを ＪＩＳの規格と比較して表１に示す。

【表１】

表 1

<table>
<tr><th rowspan="2">ねじのサイズ</th><th colspan="2">ＪＩＳ Ｂ４４３０</th><th colspan="2">本考案の具体例</th></tr>
<tr><th>みぞ数</th><th>Ｒｄ</th><th>みぞ数</th><th>Ｒｄ</th></tr>
<tr><td>Ｍ３×０．５</td><td>３</td><td>３６</td><td rowspan="4">４</td><td rowspan="4">４２</td></tr>
<tr><td>Ｍ４×０．７</td><td rowspan="4">３ or ４</td><td rowspan="4">３６
～４４</td></tr>
<tr><td>Ｍ５×０．８</td></tr>
<tr><td>Ｍ６×１</td></tr>
<tr><td>Ｍ８×１．２５</td><td rowspan="3">５</td><td rowspan="3">５０</td></tr>
<tr><td>Ｍ１０×１．５</td></tr>
<tr><td>Ｍ１２×１．７５</td><td>４</td><td>４４</td></tr>
</table>

【００２５】

上記表１中、Ｍ３～Ｍ６のサイズではみぞ数が４で割合Ｒｄが略４２％であり、Ｍ８～Ｍ１２のサイズではみぞ数が５で割合Ｒｄが略５０％であるが、Ｍ６～Ｍ８のねじサイズも含めて何れの場合もみぞ数は３以上であれば良く、割合Ｒｄは略４０～６０％の範囲内で、好ましくは略４０～５５％、更に好ましくは略４２～５１％の範囲内であれば良い。表１中のＭ６×１における本考案の具体例は

前記実施例のことである。また、表１には示されていないが、本考案の各具体例における刃厚角γの総和Σγは略９５～１５０°の範囲内で、好ましくは略９５～１４０°、更に好ましくは略１００～１２５°の範囲内で設定され、すくい角αは略－８～０°の範囲内で設定される。

【００２６】

次に、本考案の効果を更に具体的に明らかにするために、本考案品を用いてねじ立てを行った場合の幾つかの試験結果を説明する。

＜試験１＞

この試験は、従来技術のハンドタップでは１穴ねじ立てできる程度の被削材に対する本考案の効果を調べたもので、表２に示す本考案品Ａ，Ｂおよび従来品Ａ，Ｂを用いて以下の切削条件でねじ立てを行ったところ、表３に示す結果が得られた。かかる表３の結果から明らかなように、本考案品によれば、引張強さが１６９５ＭＰａ程度の高硬度被削材に対しても良好にねじ立てを行うことができるとともに、実用上十分な工具寿命が得られる。なお、耐久判定理由の「折損」はタップ本体の折れ、「摩耗大」は切れ刃の摩耗やチッピングである。

（切削条件）

ねじのサイズ：Ｍ６×１

被削材　　：ＳＫＤ６１（引張強さ１６９５ＭＰａ）

下穴形状　：φ５．００ｍｍ×２０ｍｍ

ねじ立て長さ：９ｍｍ（１．５Ｄ）

切削速度　：２．３ｍ／ｍｉｎ（１２０ｍｉｎ$^{-1}$）

切削油剤　：不水溶性切削油剤（ＪＩＳ　２種１５号）

使用機械　：立型タッピングセンタ

【００２７】

【表２】

表　2

	本考案品　A，B	従来品　A，B
母材の材質	高級粉末高速度工具鋼	高速度工具鋼
被覆	チタニウム炭窒化物	チタニウム窒化物
みぞ数	4	3
食付き山数	2．5	5
割合Ｒｄ	４２％	３７％
総和Σγ	略１２０°	略１４４°
すくい角α	－８～０°	6°

【表３】

表　3

		加工穴数	耐久判定理由
本考案品	A	５３穴	折損
	B	５８穴	折損
従来品	A	１穴	摩耗大
	B	１穴	折損

【００２８】

＜試験２＞

試験２は、試験１より少し硬い被削材に対して異なるねじサイズのねじ立てを行った場合で、表４に示す本考案品Ａ，Ｂおよび従来品Ａ，Ｂを用いて以下の切削条件でねじ立てを行ったところ、表５に示す結果が得られた。かかる表５の結果から明らかなように、本考案品によれば、引張強さが１８００ＭＰａ程度の高硬度被削材に対しても良好にねじ立てを行うことができるとともに、実用上十分な工具寿命が得られる。

（切削条件）

ねじのサイズ：Ｍ１０×１．５

被削材　　：ＳＫＤ６１（引張強さ１８００ＭＰａ）

下穴形状　　：φ８．５０ｍｍ×２５ｍｍ

ねじ立て長さ：１５ｍｍ（１．５Ｄ）

切削速度　　：２．２ｍ／ｍｉｎ（７０ｍｉｎ$^{-1}$）

切削油剤　　：不水溶性切削油剤（ＪＩＳ　２種１５号）

使用機械　　：立型タッピングセンタ

【００２９】

【表４】

表　4

	本考案品　A，B	従来品　A，B
母材の材質	高級粉末高速度工具鋼	高速度工具鋼
被覆	チタニウム炭窒化物	チタニウム窒化物
みぞ数	5	4
食付き山数	5	5
割合Ｒｄ	５０％	４４％
総和Σγ	略１３６°	略１２０°
すくい角α	－８～０°	6°

【表５】

表　5

		加工穴数	耐久判定理由
本考案品	A	６０穴以上	継続可能
	B	６０穴以上	継続可能
従来品	A	2穴	折損
	B	4穴	折損

【００３０】

＜試験３＞

試験３は、試験２と同じねじサイズで硬さを更に上げた被削材に対してねじ立てを行った場合で、前記表４に示す本考案品Ａ，Ｂおよび従来品Ａ，Ｂを用いて以下の切削条件でねじ立てを行ったところ、表６に示す結果が得られた。かかる表６の結果から明らかなように、本考案品によれば、引張強さが２０００ＭＰａ程度の高硬度被削材に対しても良好にねじ立てを行うことができるとともに、実用上十分な工具寿命が得られる。

（切削条件）

ねじのサイズ：Ｍ１０×１．５

被削材　　：ＳＫＤ６１（引張強さ２０００ＭＰａ）

下穴形状　　：φ８．５０ｍｍ×２５ｍｍ

ねじ立て長さ：１５ｍｍ（１．５Ｄ）

切削速度　　：１．１ｍ／ｍｉｎ（３５ｍｉｎ$^{-1}$）

切削油剤　　：不水溶性切削油剤（ＪＩＳ　２種１５号）

使用機械　　：立型タッピングセンタ

【００３１】

【表６】

表　6

		加工穴数	耐久判定理由
本考案品	A	５０穴以上	継続可能
	B	５０穴以上	継続可能
従来品	A	1穴	折損
	B	1穴	折損

【００３２】

以上、本考案の実施例および試験結果を詳細に説明したが、これ等はあくまでも一具体例で、例えばねじれみぞタップにも本考案は同様に適用され得るし、前記チタニウム炭窒化物の被覆やすくい角α等の条件は必ずしもねじ部１４の全域で満足している必要はなく、例えば負荷が大きい食付き部だけでも良いなど、本考案は当業者の知識に基づいて種々の変更，改良を加えた態様で実施することができる。

CLAIMS

[Utility model registration claim]
[Claim 1] It is a hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 3-12mm. While the base material consists of high-class powder rapid tool steels and the front face of a thread part is covered with titanium carbon nitride, a number of flutes is three or more. For the path of a groove bottom, within the limits of 40 - 60% of the abbreviation for the outer diameter of a thread part, total of an edge thickness angle is a hand tap for high degree-of-hardness material to which it is characterized by the rake angle of a cutting edge being within the limits of -8-0 degree of abbreviation within the limits of 95-150 degrees of abbreviation.
[Claim 2] For total of said edge thickness angle, within the limits of 42 - 51% of the abbreviation for the outer diameter of a thread part, the path of said groove bottom is a hand tap for high degree-of-hardness material according to claim 1 which is within the limits of 100-125 degrees of abbreviation.
[Claim 3] The path of 4 and a groove bottom is a hand tap for high degree-of-hardness material according to claim 1 or 2 whose number of flutes it is a hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 3-6.5mm, and is 42% of the abbreviation for the outer diameter of a thread part.
[Claim 4] The path of 5 and a groove bottom is a hand tap for high degree-of-hardness material according to claim 1 or 2 whose number of flutes it is a hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 6.5-12mm, and is 50% of the abbreviation for the outer diameter of a thread part.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed explanation of a design]
[0001]
[Industrial Application]
This design starts the hand tap which carries out cutting of the female screw, and especially, also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent, high efficiency processing is possible for it, and it is related with the hand tap for high degree-of-hardness material from which a longevity life is obtained.
[0002]
[Description of the Prior Art]
Although the hand tap is widely used in order to carry out cutting of the female screw, the basic structure of such a hand tap is finely prescribed by JIS according to the dimension of a female screw, for example, it is JIS. It is set to B4430 about "the ordinary hand tap for metric coarse screw threads." According to the convention of this JIS, the quality of the material of a hand tap is specified as alloy tool steel SKS2, high speed tool steel SKH9, or the thing that has the engine performance more than these and an EQC on use. Moreover, it is the straight fluted tap which covered the titanium nitride, and the thing of 3 groove specification made into within the limits some of [at least] whose bowstring hook angles (equivalent to a rake angle) of the cutting edge of a thread part are -9–1 degrees is indicated by JP,61-244412,A. Drawing 3 is the thing of 3 grooves with the thread-part sectional view of an example of the usual hand tap by convention of Above JIS, and, as for drawing 4 , the front face is covered with the thread-part sectional view of the hand tap of a publication by the above-mentioned official report with the titanium nitride 40.
[0003]
[Problem(s) to be Solved by the Device]
However, when tapping was performed to the **-ed material of a high degree of hardness whose tensile strength is 1250 - 2080MPa extent using the usual hand tap by convention of said JIS, faults, such as breakage of a tap body, a deficit of a cutting edge, a chipping, and early wear, arose, and practically sufficient processing efficiency and a tool life were not acquired. In the case of the hand tap which covered the titanium nitride, since abrasion resistance improves, the tool life which was excellent to the **-ed material of the usual degree of hardness comes to be acquired, but to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent, neither breakage of a tap body nor the deficit of a cutting edge can perform tapping processing too. When tensile strength incidentally tried tapping of M6x1 to the alloy tool steel SKD61 of 1695MPa(s) using what covered the titanium nitride on the front face of the hand tap made from a rapid tool steel, tapping became impossible by the anomalous attrition resulting from the chipping of a cutting edge in only 1 hole.
[0004]
Also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent, high efficiency processing is possible for the place which succeeded in this design against the background of the above situation, and is made into the purpose, and it is to offer the hand tap for high degree-of-hardness material from which a longevity life is obtained.
[0005]
[The 1st means for solving a technical problem]
In order to attain this purpose, the 1st design is a hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 3-12mm. While the base material consists of high-class powder rapid tool steels and the front face of a thread part is covered with titanium carbon nitride, a number of flutes is three or more. Within the limits of 40 - 60% of the abbreviation for the outer diameter of a thread part, the path of a groove bottom is characterized [the rake angle of a cutting edge] by being within the limits of -8-0 degree of abbreviation by total of an edge thickness angle within the limits of 95-150 degrees of abbreviation.
[0006]
In addition, the above-mentioned high-class powder high speed tool steel is powder high speed tool steel proposed in JP,5-171373,A, and it has the presentation which is not boiled till then. Namely, by W equivalence (W+1.8Mo wait %) exceeding 20%, when Co and V were more than 5 wait %s, the base material hardness of the tap attained only to abbreviation 66HRC with the conventional technique became possible to 70HRC(s).
[0007]
[Function]
In such a hand tap for high degree-of-hardness material, since titanium carbon nitride is covered by the front face of the thread part which performs cutting while high intensity and high rigidity are acquired fundamentally, since a base material is high-class powder high speed tool steel, the abrasion resistance which was excellent also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent as compared with covering of said titanium nitride is obtained. Moreover, a number of flutes is the same as a convention of three or more, i.e., JIS, or is more than it, and since the amount of infeeds per one cutting edge of a bevel lead will become small if a number of flutes is made [many], the burden of the cutting edge at the time of cutting is mitigated. However, if a number of flutes is made [many], maintaining the discharging efficiency of a chip, although edge thickness will become narrow and the burden of a cutting edge will be mitigated, since it becomes easy to produce faults, such as a deficit, as for a number of flutes, 1 or increasing about two are a limit from a convention of JIS.
[0008]
Within the limits of 40 - 60% of the abbreviation for the outer diameter (minor diameter of the female screw which should be processed) of a thread part, the path of a groove bottom is larger compared with the usual hand tap, and reinforcement and its rigidity improve and it stops being able to break easily. Reinforcement and rigidity improve so that the rate of the path of a groove bottom to

an outer diameter is large, but since the cross section of a groove becomes small and it becomes easy to produce chip packing as this rate becomes large, the above-mentioned range is appointed in consideration of such advantages and disadvantages. Moreover, since the magnitude of a chip, i.e., the height of the screw thread, needs to become large relatively and it needs to secure the big groove cross section so that it is not proportional to the outer diameter of a thread part but the outer diameter of a thread part becomes small, it is so desirable that the outer diameter of a thread part becomes small to make the above-mentioned rate low. That is, the 40 - 60 above-mentioned% of range is taken into consideration and appointed also about the difference of the outer diameter of a thread part, when an outer diameter is large, the thing of above-mentioned within the limits comparatively set up by part for a high-pass area part is desirable, and when an outer diameter is small, the thing of above-mentioned within the limits comparatively set up by part for a low-pass area part is desirable. With a number of flutes, i.e., a number of cutting teeth, in order to change and for the ease of generating of chip packing to change, it is necessary to take the magnitude of a chip into consideration also about a number of flutes on the occasion of a setup of the path of the above-mentioned groove bottom.

[0009]

Since the cross section of a groove becomes small and chip packing becomes easy to produce total of an edge thickness angle as an include angle becomes large although edge thickness becomes large, reinforcement and rigidity become high and it is hard coming to generate faults, such as a deficit, so that this include angle is large within the limits of 95-150 degrees of abbreviation, the above-mentioned include-angle range is appointed in consideration of such advantages and disadvantages. Moreover, the edge thickness and the groove cross section which are one become small, so that there are many numbers of flutes, and since the magnitude of a chip changes with the outer diameters and numbers of flutes of a thread part, in consideration of such a number of flutes or the outer diameter of a thread part, the above-mentioned include-angle range is appointed at sufficient reinforcement and rigidity being acquired, without producing chip packing. In other words, the edge thickness in each hand tap will be set up by above-mentioned include-angle within the limits in consideration of a number of flutes or the outer diameter of a thread part.

[0010]

Since the rake angle of a cutting edge is within the limits of -8-0 degree of abbreviation, the lip angle in the cutting edge constituted by the rake face and the periphery flank and a right-angled cross section becomes large compared with the usual hand tap, reinforcement and rigidity improve, and generating of a cutting-edge chip or a chipping is controlled. Although a lip angle becomes large in a rake angle being small (it becoming large at a minus side) and the reinforcement of a cutting edge and rigidity improve, since cutting force becomes large as a rake angle becomes small, the above-mentioned range is appointed in consideration of such advantages and disadvantages. Moreover, if a negative rake angle is adopted in this way, since the chip in the case of **-ed [high degree-of-hardness] material becomes a shear form and it is divided comparatively small, even if the groove cross section becomes small by enlarging the path and edge thickness of said groove bottom, chip packing will be avoided good.

[0011]

[Effectiveness of the 1st design]

According to the hand tap for high degree-of-hardness material of this design, according to the minor diameter of the female screw which should be processed, i.e., the outer diameter of a thread part, thus, by setting up suitably the path of a number of flutes or a groove bottom, edge thickness, and a rake angle within the limits of [above-mentioned] predetermined While a base material's being high-class powder high speed tool steel, and conjointly excellent reinforcement and rigidity come to be acquired, controlling the rise of the cutting force by chip packing etc. High abrasion resistance comes to be obtained by covering of titanium carbon nitride, and high efficiency processing is possible also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent. For example, while being able to perform tapping now after heat treatment, practically sufficient tool life comes to be acquired.

[0012]

[The 2nd means for solving a technical problem]

The 2nd design is characterized by being within the limits whose total of said edge thickness angle is 100-125 degrees of abbreviation in the hand tap for high degree-of-hardness material of the 1st design of the above by within the limits whose path of said groove bottom is 42 - 51% of the abbreviation for the outer diameter of a thread part.

[0013]

[An operation and effectiveness of the 2nd design]

That is, as compared with the 1st design, controlling the rise of the cutting force by chip packing etc. about the path and edge thickness of a groove bottom, the hand tap for high degree-of-hardness material of this 2nd design is what limited the setting range so that further excellent reinforcement and rigidity may be acquired, and its workability ability to **-ed [high degree-of-hardness] material improves further.

[0014]

[The 3rd means for solving a technical problem]

The 3rd design is for carrying out cutting of the female screw whose minor diameter is 3-6.5mm among the hand taps for high degree-of-hardness material of the 1st design of the above, or the 2nd design, and is characterized by considering the path of 4 and a groove bottom for a number of flutes as 42% of the abbreviation for the outer diameter of a thread part.

[0015]

[An operation and effectiveness of the 3rd design]

This 3rd design is a thing about the hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 3-6.5mm. Since the outer diameter of a thread part was comparatively as small as 3-6.5mm, in consideration of the discharging efficiency of a chip etc., the path of 4 and a groove bottom was limited for the number of flutes to 42% of the abbreviation for the outer diameter of a thread part. Practically sufficient tool life in which high efficiency processing is possible is acquired also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent.

[0016]

[The 4th means for solving a technical problem]

The 4th design is for carrying out cutting of the female screw whose minor diameter is 6.5-12mm among the hand taps for high degree-of-hardness material of the 1st design of the above, or the 2nd design, and is characterized by considering the path of 5 and a groove bottom for a number of flutes as 50% of the abbreviation for the outer diameter of a thread part.

[0017]

[An operation and effectiveness of the 4th design]

This 4th design is a thing about the hand tap for high degree-of-hardness material for carrying out cutting of the female screw whose path of a trough is 6.5-12mm. Since the outer diameter of a thread part was comparatively as large as 6.5-12mm, in consideration of the discharging efficiency of a chip etc., the path of 5 and a groove bottom was limited for the number of flutes to 50% of the

abbreviation for the outer diameter of a thread part. Practically sufficient tool life in which high efficiency processing is possible is acquired also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent.
[0018]
[Example]
Hereafter, the example of this design is explained to a detail based on a drawing.
Drawing 2 is the front view which looked at the hand tap 10 (only henceforth a hand tap 10) for high degree-of-hardness material which is one example of this design from the axial center and the right-angled direction, and the male screw whose outer diameter corresponding to the female screw which it should process into a thread part 14 while a pitch is in 6mm for carrying out cutting of the female screw which is 1mm and the path of M6x1, i.e., a trough, is equipped with the shank section 12 and a thread part 14 is 6mm is formed. Although drawing 1 is the axial center O of a thread part 14, and a right-angled sectional view, four straight flutes 16 are formed in an axial center and parallel at a thread part 14, it is divided by four lands 18, and the cutting edge 20 is formed in the edge of each land 18. As for the base material of this hand tap 10, said W equivalence (W+1.8Mo wait %) exceeds 20%, it is the high-class powder rapid tool steel Co and whose V are more than 5 wait %s, and the front face of a thread part 14 is covered with titanium carbon nitride 22. Titanium carbon nitride 22 can be formed by CDV etc. Moreover, the width of face (edge thickness) of four lands 18 is equal, the rate Rd to the outer diameter D of a thread part 14 of the path Df of the groove bottom of the above-mentioned straight flute 16 (%), x100 [i.e., (Df/D),], is 42% of abbreviation, and alpha is [total sigmagamma of the edge thickness angle gamma is 120 degrees of abbreviation, and] about -8-0 degree in rake angle of a cutting edge 20. In addition, the broken line 24 of drawing 1 expresses the root of thread.
[0019]
In such a hand tap 10, since titanium carbon nitride 22 is covered by the front face of the thread part 14 which performs cutting while high intensity and high rigidity are acquired fundamentally, since a base material is high-class powder high speed tool steel, the abrasion resistance which was excellent also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent as compared with covering of a titanium nitride is obtained. Moreover, four straight flutes 16 are formed, and by convention of JIS, although it is "3 or 4", since there is much one and the amount of infeeds per one cutting edge of a bevel lead becomes small to generally being "3", the burden of the cutting edge 20 at the time of cutting is mitigated by about 3/4. If a number of flutes increases, although edge thickness will become narrow and the burden of a cutting edge 20 will be mitigated, it becomes easy to produce faults, such as a deficit, but in this example, since a number of flutes is 4, the burden of a cutting edge 20 is mitigable, avoiding faults, such as a deficit.
[0020]
Rd is large compared with being 42% of abbreviation and the case of the usual hand tap being [of the path of a groove bottom] about 36% of abbreviation, and reinforcement and its rigidity improve and it stops being able to break comparatively easily. Compared with Rd=36% of case, breakage-proof nature improves in proportion to (42/36) of squares. Although reinforcement and rigidity improve so that Rd is comparatively large While the groove cross section's becoming small and becoming easy to produce chip packing as this rate Rd becomes large Since the magnitude of a chip differs with the outer diameter of a thread part 14, i.e., the magnitude and the number of flutes of a female screw which should be processed, and the ease of generating of chip packing is different, an above-mentioned Rd**42% figure It is determined that sufficient reinforcement and rigidity are acquired without spoiling chip eccritic synthetically in consideration of it etc.
[0021]
As compared with a number of flutes, it is large at 120 degrees of abbreviation, reinforcement and rigidity comparatively large each edge thickness and high are acquired, and faults, such as a deficit, cannot produce total sigmagamma of the edge thickness angle gamma easily. The groove cross section becomes small and it becomes easy to produce chip packing as total sigmagamma will become large, if the number of flutes is the same, but since the magnitude of a chip changes with the outer diameters and numbers of flutes of a thread part 14, the above-mentioned sigmagamma**120 degree figure is set that sufficient reinforcement and rigidity are acquired, without producing chip packing in consideration of such a number of flutes, the outer diameter of a thread part 14, etc.
[0022]
Since rake angle alpha of a cutting edge 20 is about -8-0 degree of abbreviation, the lip angle beta in the cutting edge 20 constituted by the rake face 26 and the periphery flank 28 and a right-angled cross section becomes about 90 degrees of abbreviation, and more than it, since it is large compared with the usual hand tap, reinforcement and rigidity improve and generating of a cutting-edge chip or a chipping is controlled. Although the lip angle beta becomes large in rake angle alpha being small (it becoming large at a minus side) and the reinforcement of a cutting edge 20 and rigidity improve, since cutting force becomes large as rake angle alpha becomes small, the above-mentioned rake angle alpha is defined in consideration of such advantages and disadvantages. Moreover, since the chip when performing tapping to **-ed [high degree-of-hardness] material becomes a shear form and is divided comparatively small when rake angle alpha is negative in this way, even if the groove cross section becomes small by enlarging Path Df and edge thickness of said groove bottom, chip packing is avoided good.
[0023]
Therefore, according to the hand tap 10 of such this example, the reinforcement which was excellent while controlling the rise of the cutting force by chip packing etc., rigidity, and abrasion resistance come to be obtained, and while high efficiency processing can be possible, for example, being able to perform tapping now after heat treatment also to the **-ed [high degree-of-hardness] material whose tensile strength is 1250 - 2080MPa extent, practically sufficient tool life comes to be acquired.
[0024]
In addition, although the size of **** explained the hand tap 10 of M6x1 concretely in the upper example, this design can be applied to the hand tap of the various sizes of M3-M12 within the limits by the call, and shows the rate Rd of the path of a number of flutes and a groove bottom in Table 1 about some of the examples as compared with the specification of JIS.
[Table 1]

表 1

ねじのサイズ	ＪＩＳ Ｂ４４３０		本考案の具体例	
	みぞ数	Ｒｄ	みぞ数	Ｒｄ
Ｍ３×０．５	３	３６	４	４２
Ｍ４×０．７	３ or ４	３６～４４		
Ｍ５×０．８				
Ｍ６×１				
Ｍ８×１．２５			５	５０
Ｍ１０×１．５				
Ｍ１２×１．７５	４	４４		

[0025]
Among the above-mentioned table 1, in the size of M3-M6, a number of flutes is [Rd] 42% of abbreviation comparatively in 4, and with the size of M8-M12, by 5, comparatively, although Rd is 50% of abbreviation, a number of flutes Rd should just be [that numbers of flutes also including the screw-thread size of M6-M8 should just be three or more in any case] within the limits of 42 - 51% of abbreviation still more preferably 40 - 55% of abbreviation preferably within the limits of 40 - 60% of abbreviation comparatively. The example of this design in M6x1 in Table 1 is said example. Moreover, although not shown in Table 1, total sigmagamma of the edge thickness angle gamma in each example of this design is set up within the limits of 100-125 degrees of abbreviation still more preferably 95-140 degrees of abbreviation preferably within the limits of 95-150 degrees of abbreviation, and rake angle alpha is set up within the limits of -8-0 degree of abbreviation.
[0026]
Next, in order to clarify effectiveness of this design still more concretely, some test results at the time of using this article and performing tapping are explained.
<Trial 1> This trial was what investigated the effectiveness of this design to the **-ed material of extent which can carry out 1 hole tapping in the hand tap of the conventional technique, and when tapping was performed by the following cutting conditions using Elegance A and B this elegance A and B shown in Table 2, and conventionally, the result shown in Table 3 was obtained. While being able to perform tapping good also to the **-ed [high degree-of-hardness] material whose tensile strength is 1695MPa extent according to this elegance so that clearly from the result of this table 3, practically sufficient tool life is acquired. In addition, "breakage" of the reason for a durable judging is a crease of a tap body, and "wear size" is wear and the chipping of a cutting edge.
(Cutting conditions)
Size of a screw thread: M6x1 **-ed material : SKD61 (tensile strength 1695MPa)
Prepared-hole configuration : phi5.00mmx20mm Tapping die length: 9mm (1.5D)
Cutting speed :2.3 m/min (120min-1)
Cutting fluid : non-water-soluble-cutting-oil agent (JIS 2 sort 15 No.)
Machine used : ** type tapping center [0027]
[Table 2]

表 2

	本考案品 A，B	従来品 A，B
母材の材質	高級粉末高速度工具鋼	高速度工具鋼
被覆	チタニウム炭窒化物	チタニウム窒化物
みぞ数	4	3
食付き山数	２．５	5
割合Ｒｄ	４２％	３７％
総和Σγ	略１２０°	略１４４°
すくい角α	－８～０°	6°

[Table 3]

表 3

		加工穴数	耐久判定理由
本考案品	A	5 3穴	折損
	B	5 8穴	折損
従来品	A	1穴	摩耗大
	B	1穴	折損

[0028]
<Trial 2> When tapping was performed by the following cutting conditions using Elegance A and B this elegance A and B shown in Table 4 by the case where trial 2 performs tapping of different **** size to **-ed material somewhat harder than trial 1, and conventionally, the result shown in Table 5 was obtained. While being able to perform tapping good also to the **-ed [high degree-of-hardness] material whose tensile strength is 1800MPa extent according to this elegance so that clearly from the result of this table 5, practically sufficient tool life is acquired.
(Cutting conditions)
Size of a screw thread: M10x1.5 **-ed material : SKD61 (tensile strength 1800MPa)
Prepared-hole configuration : phi8.50mmx25mm Tapping die length: 15mm (1.5D)
Cutting speed :2.2 m/min (70min-1)
Cutting fluid : non-water-soluble-cutting-oil agent (JIS 2 sort 15 No.)
Machine used : ** type tapping center [0029]
[Table 4]

表 4

	本考案品 A, B	従来品 A, B
母材の材質	高級粉末高速度工具鋼	高速度工具鋼
被覆	チタニウム炭窒化物	チタニウム窒化物
みぞ数	5	4
食付き山数	5	5
割合Rd	5 0%	4 4%
総和Σγ	略1 3 6°	略1 2 0°
すくい角α	−8〜0°	6°

[Table 5]

表 5

		加工穴数	耐久判定理由
本考案品	A	6 0穴以上	継続可能
	B	6 0穴以上	継続可能
従来品	A	2穴	折損
	B	4穴	折損

[0030]
<Trial 3> When tapping was performed by the following cutting conditions using Elegance A and B this elegance A and B shown in said table 4 by the case where trial 3 performs tapping to the **-ed material which raised hardness in the same **** size as trial 2 further, and conventionally, the result shown in Table 6 was obtained. While being able to perform tapping good also to the **-ed [high degree-of-hardness] material whose tensile strength is 2000MPa extent according to this elegance so that clearly from the result of this table 6, practically sufficient tool life is acquired.
(Cutting conditions)
Size of a screw thread: M10x1.5 **-ed material : SKD61 (tensile strength 2000MPa)
Prepared-hole configuration : phi8.50mmx25mm Tapping die length: 15mm (1.5D)
Cutting speed :1.1 m/min (35min-1)
Cutting fluid : non-water-soluble-cutting-oil agent (JIS 2 sort 15 No.)
Machine used : ** type tapping center [0031]
[Table 6]

表 6

		加工穴数	耐久判定理由
本考案品	A	50穴以上	継続可能
	B	50穴以上	継続可能
従来品	A	1穴	折損
	B	1穴	折損

[0032]
As mentioned above, although the example and test result of this design were explained to the detail This etc. is one example to the last, for example, this design may be similarly applied to a spiral fluted tap, and not necessarily satisfied with the whole region of a thread part 14 of conditions, such as covering, rake angle alpha, etc. of said titanium carbon nitride, -- **** -- for example, a bevel lead with a large load -- this design can carry out that it is good etc. in the mode which added various modification and amelioration based on this contractor's knowledge.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing which expanded a part of axial center in the thread part of the hand tap for high degree-of-hardness material of drawing 2 which is one example of this design, and right-angled cross section.
[Drawing 2] It is the front view which looked at the hand tap for high degree-of-hardness material which is one example of this design from the axial center and the right-angled direction.
[Drawing 3] They are an axial center in the thread part of the conventional usual hand tap, and a right-angled sectional view.
[Drawing 4] It is drawing which expanded a part of axial center in the thread part of the conventional hand tap which covered the titanium nitride on the surface of the thread part, and right-angled cross section.
[Description of Notations]
10: The hand tap for high degree-of-hardness material
14: Thread part
18: Land
20: Cutting edge
22: Titanium carbon nitride
D: The outer diameter of a thread part
Df: The path of a groove bottom
alpha: Rake angle
gamma: Edge thickness angle

[Translation done.]

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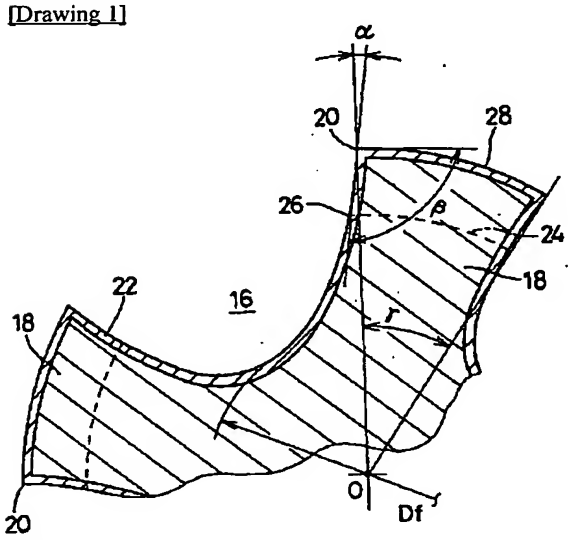
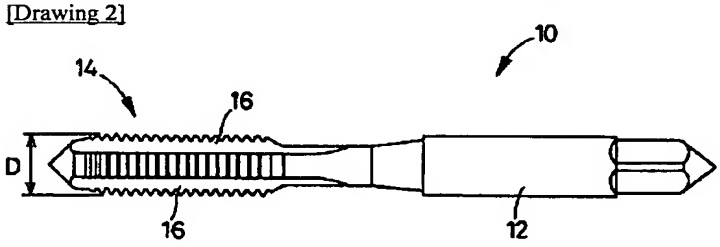
DRAWINGS

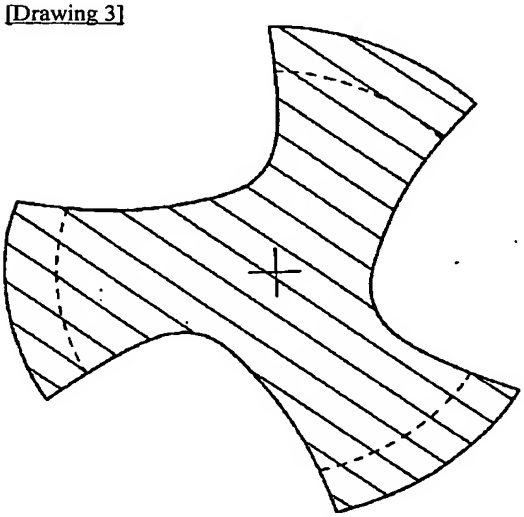
[Drawing 1]



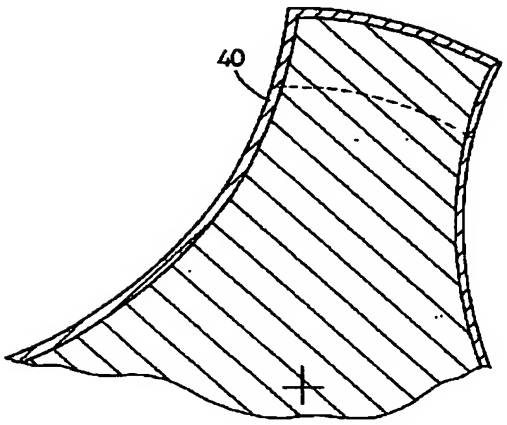
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]